

## **Historic, Archive Document**

Do not assume content reflects current scientific knowledge, policies, or practices.



1972  
499.9  
F7632US  
C88.3

FOREST SERVICE

U. S. DEPARTMENT OF AGRICULTURE

ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION

## Bark Thickness and Past Diameters of Engelmann Spruce in Colorado and Wyoming

Clifford A. Myers and Robert R. Alexander<sup>1</sup>

U. S. DEPT. OF AGRICULTURE  
NATIONAL AGRICULTURAL LIBRARY  
RECEIVED

AUG 14 1972

PROCUREMENT SECTION  
CURRENT SERIAL RECORDS

Past diameter can be estimated from present diameters and radial wood growth for any desired period. Equation constants account for any periodic change in bark thickness.

**Keywords:** Forest measurement, tree increment estimates, tree diameter measurement, *Picea engelmannii*.

Past diameters of trees on temporary plots are used to determine periodic changes in plot basal areas and volumes. Estimates of periodic growth are useful in management planning and in the derivation of growth functions for modeling changes in forest stands.<sup>2</sup> Increase in diameter at breast height is the result of increase in thickness of both wood and bark. Both must, therefore, be accounted for in con-

verting present diameters outside bark to equivalent past diameters. At least two measurements are needed for each tree, both at breast height: (1) diameter outside bark, and (2) average radial growth of wood for any desired period as measured on an increment core. Bark thickness often is not measured, since it can be estimated from relationships determined in advance from appropriate measurements on many trees.

The relationships presented below were computed from data obtained from 1,516 Engelmann spruce (*Picea engelmannii* Parry) located on nine National Forests in Colorado and southern Wyoming. Present diameters outside bark, measured with a diameter tape, ranged from 1.2 to 35.9 inches. Bark thickness at breast height was measured to the nearest 0.05 inch with a bark-measuring instrument at three points on each tree.

<sup>1</sup>Principal Mensurationist and Principal Silviculturist, respectively, Rocky Mountain Forest and Range Experiment Station, with central headquarters maintained at Fort Collins, in cooperation with Colorado State University.

<sup>2</sup>Myers, Clifford A. 1971. Field and computer procedures for managed-stand yield tables. USDA For. Serv. Res. Pap. RM-79, 24 p. Rocky Mt. For. and Range Exp. Stn., Fort Collins, Colo.

The linear relationships given below apply at breast height over the range of diameters sampled. Correlation coefficients are nearly 1.0, which is usual for these relationships.

Conversion of diameter outside bark (d.o.b.) to diameter inside bark (d.i.b.):

$$\text{d.i.b.} = 0.9502 (\text{d.o.b.}) - 0.2528 \quad [1]$$

Conversion of diameter inside bark (d.i.b.) to diameter outside bark (d.o.b.):

$$\text{d.o.b.} = 1.0508 (\text{d.i.b.}) + 0.2824 \quad [2]$$

A past diameter outside bark is computed as follows:

1. Convert present d.o.b. to present d.i.b. with equation 1.
2. Subtract twice the radial wood growth from present d.i.b. to obtain past d.i.b.
3. Convert past d.i.b. to past d.o.b. with equation 2.

For efficient use in computer programs, the two relationships can be combined so all computations appear in a single expression.

To do this, the right hand side of equation 1 minus twice radial growth is substituted for d.i.b. in equation 2. The expression is then simplified. For Engelmann spruce, the result is:

$$\text{Past d.o.b.} = 0.9985 (\text{Present d.o.b.}) - 0.0168 - 2.1017 \quad [3]$$

(radial wood growth)

Table 1 gives the past diameter for each of several combinations of present diameter and periodic radial wood growth. For example, if present diameter is 13.5 inches and radial wood growth totaled 0.85 inch for a particular period, diameter outside bark was 11.7 inches at the beginning of the period. Interpolation can be used to obtain past diameters when present diameters and amounts of radial growth differ from those given in the table. Computation using equation 3 will usually be more appropriate. Past diameters of trees with radial growth less than 0.15 inch are merely present diameters minus twice the amount of radial growth. For such trees, increase in bark thickness with unit increase in diameter is too small to affect diameters to the nearest 0.1 inch.

Table 1.--Present and past diameters of Engelmann spruce in Colorado and Wyoming

Present d.b.h. outside bark	Periodic radial wood growth in inches																	
	.15	.25	.35	.45	.55	.65	.75	.85	.95	1.05	1.15	1.25	1.35	1.45	1.55	1.65	1.75	1.85
----- Past d.b.h. outside bark in inches -----																		
1.5	1.2	1.0	0.8	0.6	0.4	0.1												
3.5	3.2	3.0	2.8	2.6	2.4	2.1	1.9	1.7	1.5	1.3	1.1	0.9	0.7	0.5	0.3			
5.5	5.2	5.0	4.8	4.6	4.4	4.1	3.9	3.7	3.5	3.3	3.1	2.9	2.7	2.5	2.3	2.0	1.8	1.6
7.5	7.2	7.0	6.8	6.6	6.3	6.1	5.9	5.7	5.5	5.3	5.1	4.9	4.7	4.5	4.2	4.0	3.8	3.6
9.5	9.2	9.0	8.8	8.6	8.3	8.1	7.9	7.7	7.5	7.3	7.1	6.9	6.7	6.5	6.2	6.0	5.8	5.6
11.5	11.2	11.0	10.8	10.6	10.3	10.1	9.9	9.7	9.5	9.3	9.1	8.9	8.7	8.5	8.2	8.0	7.8	7.6
13.5	13.2	13.0	12.8	12.6	12.3	12.1	11.9	11.7	11.5	11.3	11.1	10.9	10.7	10.4	10.2	10.0	9.8	9.6
15.5	15.2	15.0	14.8	14.5	14.3	14.1	13.9	13.7	13.5	13.3	13.1	12.9	12.7	12.4	12.2	12.0	11.8	11.6
17.5	17.2	17.0	16.8	16.5	16.3	16.1	15.9	15.7	15.5	15.3	15.1	14.9	14.7	14.4	14.2	14.0	13.8	13.6
19.5	19.2	19.0	18.8	18.5	18.3	18.1	17.9	17.7	17.5	17.3	17.1	16.9	16.7	16.4	16.2	16.0	15.8	15.6
21.5	21.2	21.0	20.7	20.5	20.3	20.1	19.9	19.7	19.5	19.3	19.1	18.9	18.6	18.4	18.2	18.0	17.8	17.6
23.5	23.2	23.0	22.7	22.5	22.3	22.1	21.9	21.7	21.5	21.3	21.1	20.9	20.6	20.4	20.2	20.0	19.8	19.6
25.5	25.2	25.0	24.7	24.5	24.3	24.1	23.9	23.7	23.5	23.3	23.1	22.9	22.6	22.4	22.2	22.0	21.8	21.6
27.5	27.2	27.0	26.7	26.5	26.3	26.1	25.9	25.7	25.5	25.3	25.1	24.8	24.6	24.4	24.2	24.0	23.8	23.6
29.5	29.2	28.9	28.7	28.5	28.3	28.1	27.9	27.7	27.5	27.3	27.1	26.8	26.6	26.4	26.2	26.0	25.8	25.6
31.5	31.2	30.9	30.7	30.5	30.3	30.1	29.9	29.7	29.5	29.3	29.1	28.8	28.6	28.4	28.2	28.0	27.8	27.6
33.5	33.2	32.9	32.7	32.5	32.3	32.1	31.9	31.7	31.5	31.3	31.0	30.8	30.6	30.4	30.2	30.0	29.8	29.6
35.5	35.1	34.9	34.7	34.5	34.3	34.1	33.9	33.7	33.5	33.3	33.0	32.8	32.6	32.4	32.2	32.0	31.8	31.6